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Subject: Evaluation of Southwestern Dwarf Mistletoe Infection in the Jacob/Ryan Analysis Area

To: District Ranger, North Kaibab Ranger District, Kaibab NF

On May 30, 2007, I visited the North Kaibab RD, Kaibab NF, at the request of Steve Boyer, District Silviculturist, to discuss and evaluate southwestern dwarf mistletoe of ponderosa pine in the Jacob Ryan Vegetation Management Project on the District. The primary objectives of the Jacob Ryan Vegetation Management Project are to reduce forest fuels, decrease fire hazard, and improve wildlife habitat. In order to meet the intent of the northern goshawk guidelines, the 30,000 acre project area has been divided into treatment areas defined by existing conditions that limit whether or not they are sustainable for uneven-aged management. Since the incidence of dwarf mistletoe infection within a stand greatly influences the growth and development of trees overtime, the prevalence of dwarf mistletoe is considered when selecting stands for even- or uneven-aged management. This report includes information on general existing stand conditions, particularly on dwarf mistletoe incidence and its influence on stand development, and makes recommendations to minimize impacts of dwarf mistletoe infection in developing stands.

Thirty-two percent of the stands in the analysis area are infected with dwarf mistletoe. The incidence of dwarf mistletoe is quantified during stand exams. Inventory trees are assigned dwarf mistletoe ratings (DMR) using Hawksworth's[i] 6-class system. This rating system divides the live crown of trees into thirds, and each third is rated separately as: 0, no mistletoe infection; 1, less than 50% of live branches infected; 2, more than 50% of live branches infected. The ratings for each third are totaled to obtain a DMR for a tree and a mean DMR for a site (stand) is calculated by adding the DMRs for all live trees, infected and uninfected, greater than 1 inch diameter at breast height (DBH) in the stand and dividing by the total number of trees. More than half of the infected sites are lightly infected (stand DMR <0.5), and about 25% are heavily to severely infected (stand DMR >1.0). There are several stands with DMR levels greater than 3.5. There are many stands in the analysis area with infection in smaller size classes, but the overstory mistletoe seed source was removed in past treatments.

Figure 1 Multi-storied stand with dwarf mistletoe infection.

We visited 4 sites and discussed whether or not uneven-aged management is appropriate or sustainable. All sites were dominated by ponderosa pine and infected with moderate levels of southwestern dwarf mistletoe. Stand exam data shows

stand average DMR levels ranging from 0.4 to 1.0, however, since the stand exams are over 8 years old, stand average DMR levels are expected to be greater than reported and did appear so.

The first site visited was a two-storied stand behind Jacob Lake lodge, which had large yellow pines interspersed among a dense stand of pole sized trees. Dwarf mistletoe infection was prevalent in all size classes but patchy. The second site had a section of fairly open pole and sapling sized trees with high dwarf mistletoe infection and the rest of the site was multi-storied and less severely infected. The last two sites were multi-storied and densely stocked. Dwarf mistletoe infection was patchy and prevalent in all size classes.

Silvicultural Management Options

The focus of managing mistletoe is frequently to reduce the impacts of mistletoe infection on forested sites. Mistletoe management is a continuous process. New dwarf mistletoe infections take 3- to 5-years (latent period) before producing aerial shoots, so not all infection can be detected and removed during one treatment. At least one treatment will be needed 5 to 10 years after an initial treatment and can be accomplished during regularly scheduled silvicultural or prescribed fire treatments.

Several features of dwarf mistletoes make them ideal candidates for cultural management[ii]:

- Dwarf mistletoes require a living host to survive. Mistletoe dies when an infected tree or branch is cut.
- Dwarf mistletoes are commonly restricted to a single host species or a group of closely related species. Non-host species can be favored during stand treatments.
- Dwarf mistletoes have fairly long life cycles and slow spread rates.
- Spread rates average only 1 foot per year. Although birds contribute to long-distance dispersal of seeds, this is rare and of little practical significance from a control perspective.
- Southwestern dwarf mistletoe-infected ponderosa pine trees are generally easy to detect due to the presence of yellow-orange shoots and witches' brooms. Trees in heavily infested stands show signs of short stature, decline, and mortality.

Managing dwarf mistletoe is difficult in stands under uneven-age management because younger trees become heavily diseased from seeds showering down from infected overstory trees. Spread from overstory to understory is rapid. Initially, all infections in the young stand develop directly from seeds produced from overstory trees. Then there is a transition period when infections in the young stand begin to produce seeds that further infect the stand. Subsequently, infection in the young stand progresses outward beyond the range of the seeds produced in the overstory stand. Researchers[iii] [iv] measured the distance of infected seedlings from the source of overstory trees at different time intervals. In 20-year-old trees, nearly all infection was found to be attributable to seed produced in the overstory with 80 percent of infected seedlings within 35 feet of the infected overstory trees. In 50-year-old trees, lateral spread accounted for about one-half of the spread in open stands and one-third of the total in dense stands, with distances from the original overstory seed source reaching nearly 80 feet and 65 feet, respectively.

If uneven-aged treatments are to be applied in dwarf mistletoe infected stands, the sites should have very low levels of mistletoe and the mistletoe dispersed in defined patches. Group selection could be used to effectively remove infected trees and limit spread.

Prescribed burns can also be used to reduce dwarf mistletoe infection levels. Heavily infected trees have been shown to have reduced post-burn survival rates compared to lightly infected or non-infected trees[v] [vi]. Limbs located in the lower crowns of trees are killed during fire. Since dwarf mistletoe infections are generally more abundant in the lower crowns of infected trees, infection levels are decreased by the death of lower limbs.

Recommendations

Dwarf mistletoes markedly affect the growth, form, and survival of infected trees. Treatments to mitigate mistletoe impacts should be integrated with other treatment activities like reducing a stands susceptibility to fire or insect outbreaks. Uneven-aged treatments should only be considered in non-dwarf mistletoe infected stands or lightly infected stands that have well defined infection patches in which group selection can be used to target the removal of infected trees.

Even-aged treatments are recommended in moderately to heavily dwarf mistletoe infected stands. Moderately infected stands that are adequately stocked can be thinned by targeting the more severely infected trees while also emphasizing the most vigorously growing trees. Increasing space between trees helps limit spread because seeds of dwarf mistletoe are explosively released and typically travel 10 to 40 feet from a fruit bearing plant. This reduces infection levels while still allowing trees to grow to maturity. Heavily infected stands should either receive a regeneration treatment, such as a shelterwood, or be deferred from treatment. Regardless of the emphasis on even-aged or uneven-aged stands, monitoring for followup treatments in 5 to 10 years is recommended.

Thinning slash may pose a short-term risk to residual trees in the thinning units or surrounding areas depending on the timing of thinning, local population of pine engraver beetles, and site and environmental factors such as site quality and precipitation. Our office recommends that slash be generated between late summer and the end of December, if possible, in order to lessen the buildup of ips bark beetles. Slash piles should be placed in stand openings as much as possible and the largest diameter slash put on the outside of the pile to promote quick drying. Tepee style slash piles with branches and small-diameter slash in the middle and the larger diameter material on the outside.

If you have any questions, please give me a call at (928) 556-2075.

/s/ Mary Lou Fairweather
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cc: Stephen F Boyer
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[i] Hawksworth, F.G. 1977. The 6-class dwarf mistletoe rating system. USDA Forest Service, General Technical Report RM-48. 7pp.

[ii] Johnson, David W.; Hawksworth, Frank G. 1985. Candidates for control through cultural management. In: Loomis, Robert C; Tucker, Susan; Hofacker, Thomas H. Insect and disease conditions in the United States, 1979-83: What else is growing in our forests? Gen. Tech. Rep. WO-46. Washington, DC: U.S. Department of Agriculture, Forest Service, State and Private Forestry, Forest Pest Management: 48-55.

[iii] Gill, L.S. and F.G. Hawksworth. 1954. Dwarf mistletoe control in southwestern ponderosa pine forests under management. Jour. Forestry 52: 347-353.

[iv] Hawksworth, F.G. 1961. Dwarf mistletoe of ponderosa pine in the Southwest. Tech. Bull. 1246. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station. 13p.

[v] Alexander, M.E. and F.G. Hawksworth. 1976. Fire and dwarf mistletoes in North American coniferous forests. Jour. Forestry. 74 (7): 446-449.

[vi] Conklin, D.A. and W.A. Armstrong. 2001. Effects of three prescribed fires on dwarf mistletoe infection in southwestern ponderosa pine. USDA Forest Service, Southwestern Region, Forestry and Forest Health. R3-01-02. 17 p.